Assessment of Impacts from Groundwater Control Projects

Martin Preene

Technical Development Director, Golder Associates

Golder Associates

Synopsis

- What is groundwater control?
- Potential impacts
- Case studies
- The future
- Conclusion

Golder Associates

Groundwater control

Definition

"The process of temporarily dealing with groundwater, to allow excavations to be made in dry and stable conditions below natural groundwater level"

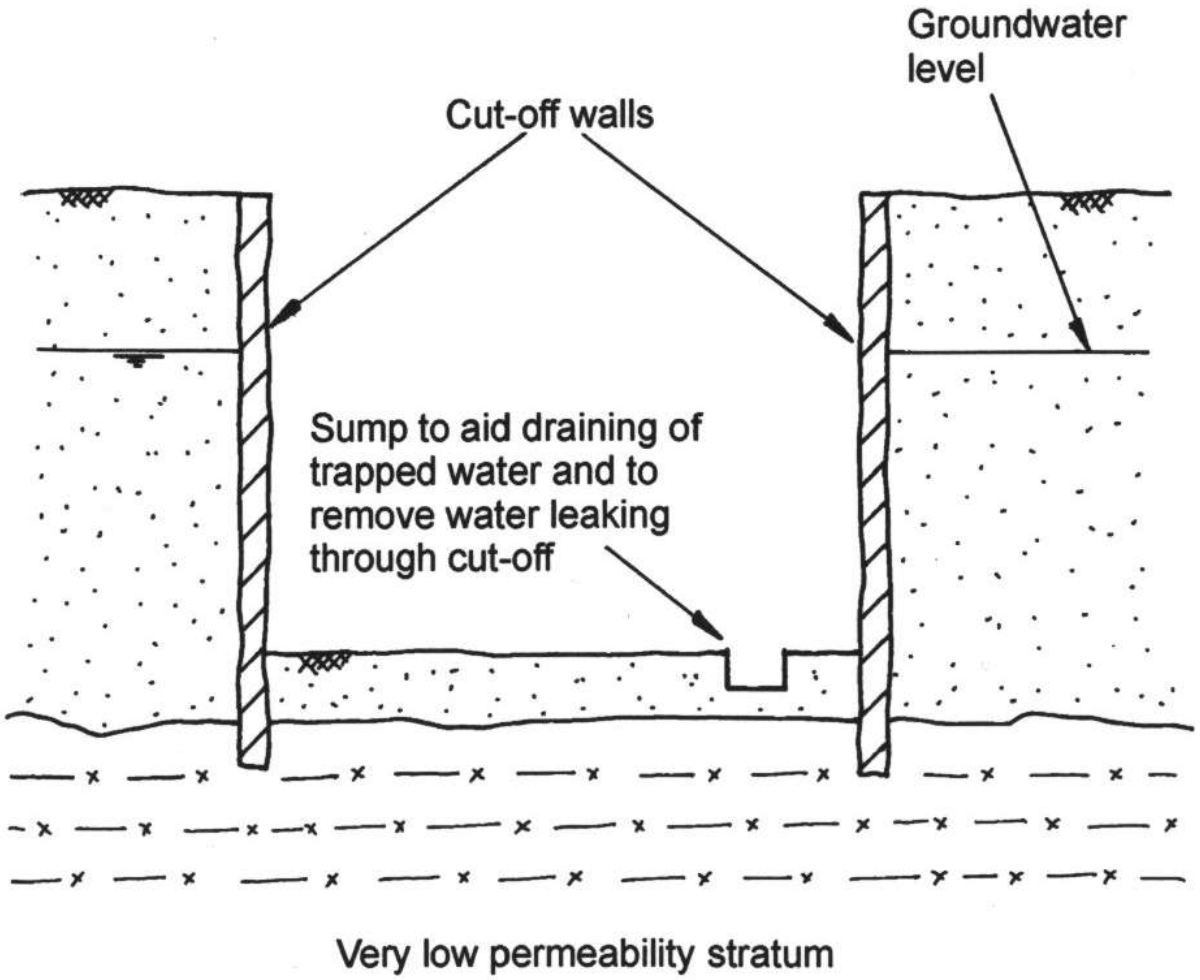
Golder Associates

Groundwater control

- Exclusion: Physical cut-off walls
- Pumping: Arrays of wells or sumps (construction dewatering)

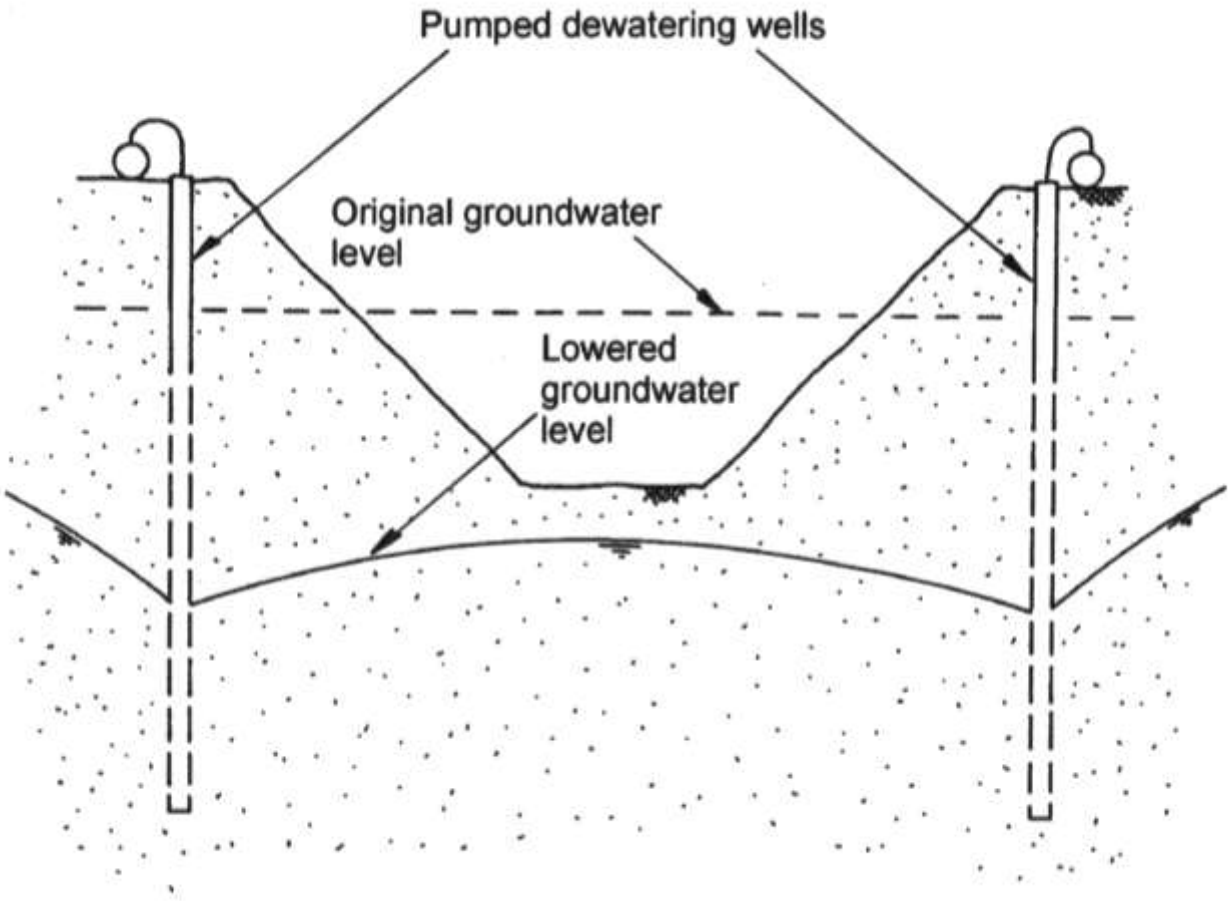
Golder Associates

Groundwater control by exclusion



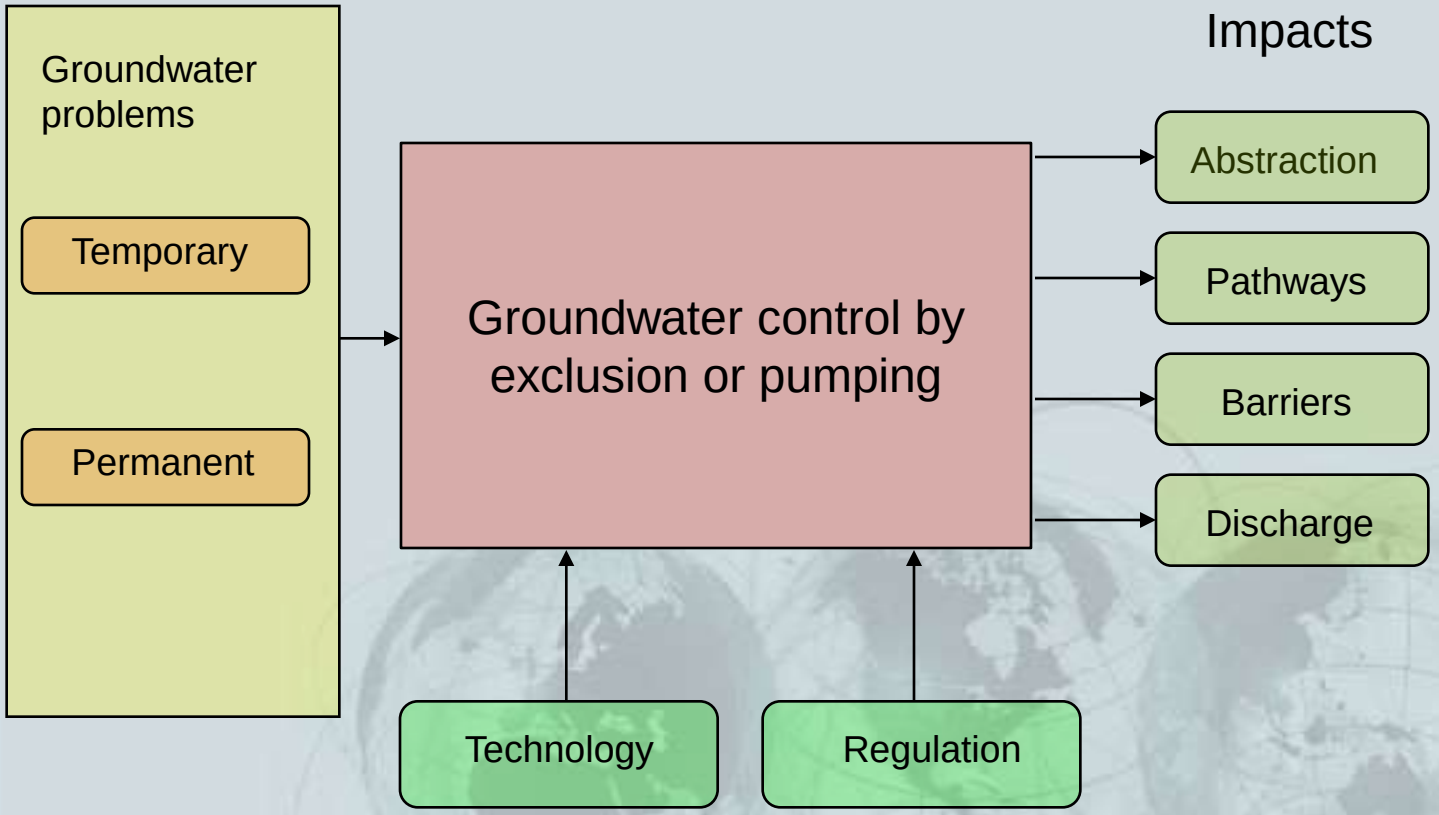
Cut-off walls penetrate into underlying low permeability stratum

Groundwater control by pumping



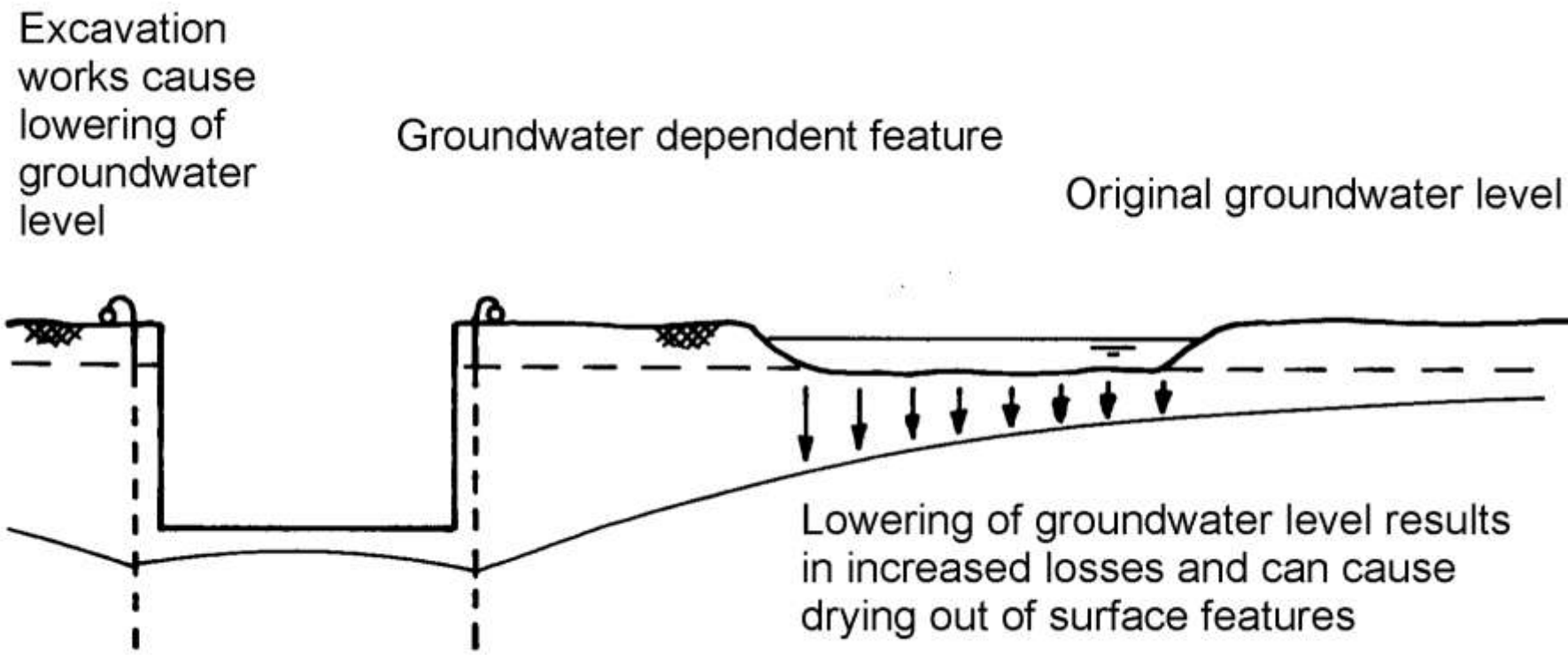
Groundwater control

- Groundwater control is part of a wider picture



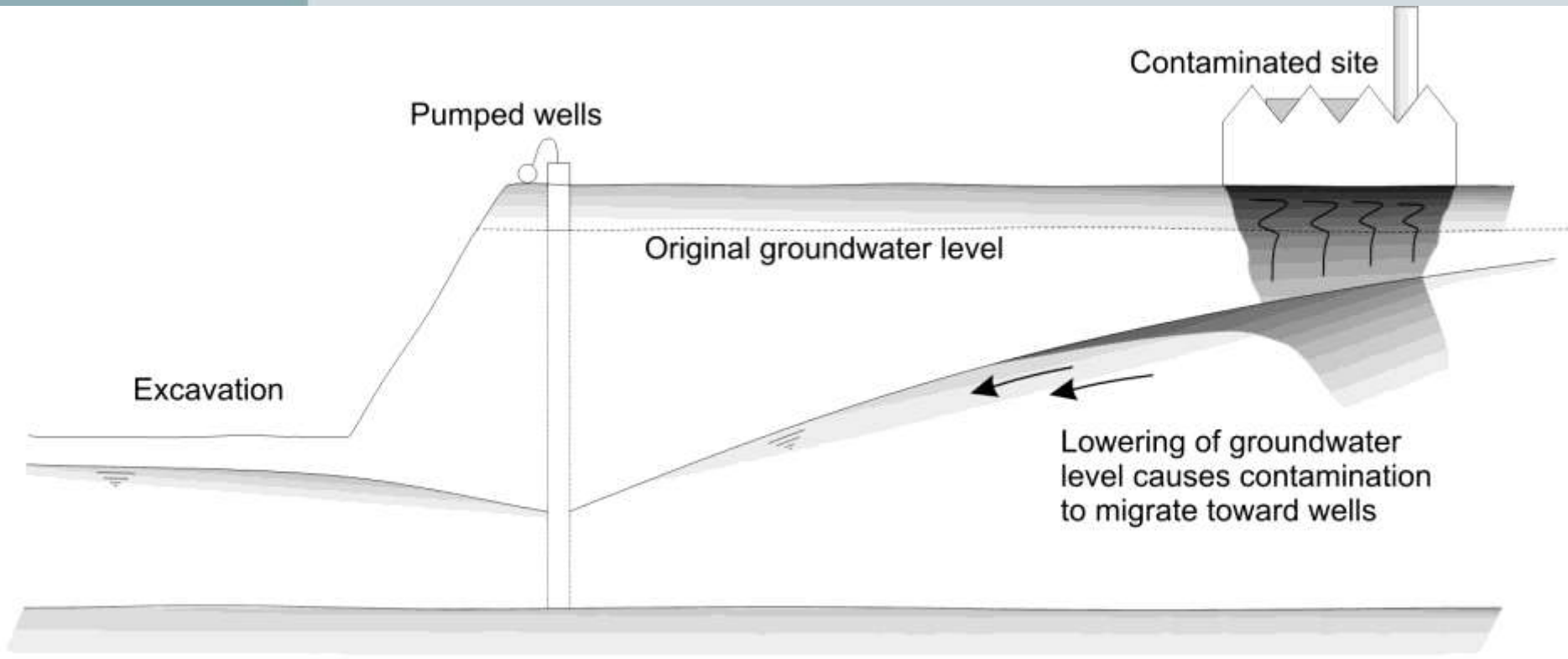
Groundwater impacts

- It is widely recognised that impacts can result from abstraction for groundwater control purposes



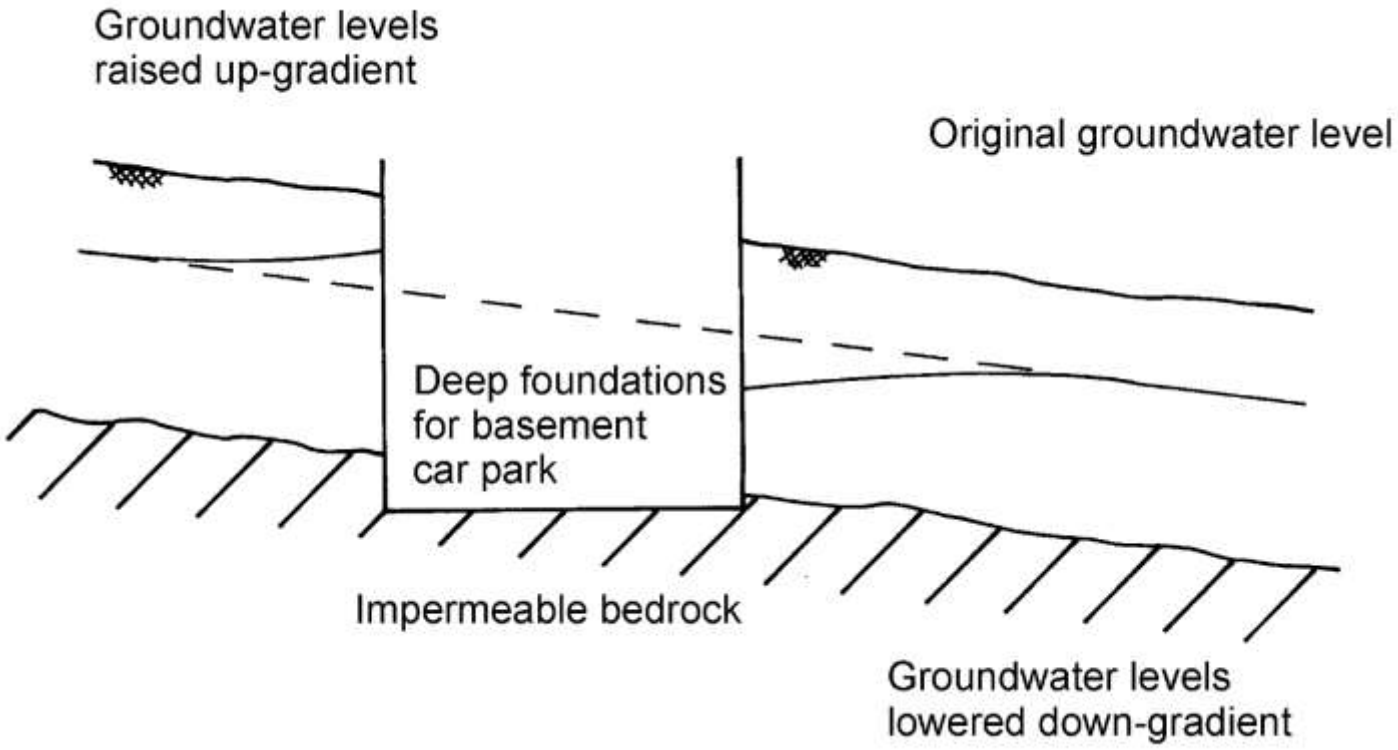
Groundwater impacts

- It is widely recognised that impacts can result from abstraction for groundwater control purposes



Groundwater impacts

- It is less widely recognised that groundwater impacts can result even where no abstraction is proposed



Golder Associates

Potential groundwater impacts

Impact 1: Abstraction
- e.g. settlement, impact on water sources

Impact 2: Pathways for groundwater flow
- e.g. increased risk of aquifer pollution

Impact 3: Barriers to groundwater flow
- e.g. changes in groundwater level

Impact 4: Discharges to groundwater
- e.g. risk of fuel spills, etc

Impact 5: Discharge to surface water
- e.g. risk of pollution of surface waters

Based on Preene and Brassington (2003)

Golder Associates

Case studies

- Pathways
- Barriers
- Discharge to surface waters

Golder Associates

Case studies - pathways

- Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow
- Example: pipeline construction through inner Source Protection Zone of Public Water Supply source

Golder Associates

Case studies - pathways

- Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow
- Example: Cut and cover tunnel for river crossing portal penetrating into confined aquifer

Golder Associates

Case studies - pathways

- Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow
- Example: Cut and cover tunnel for river crossing portal penetrating into confined aquifer

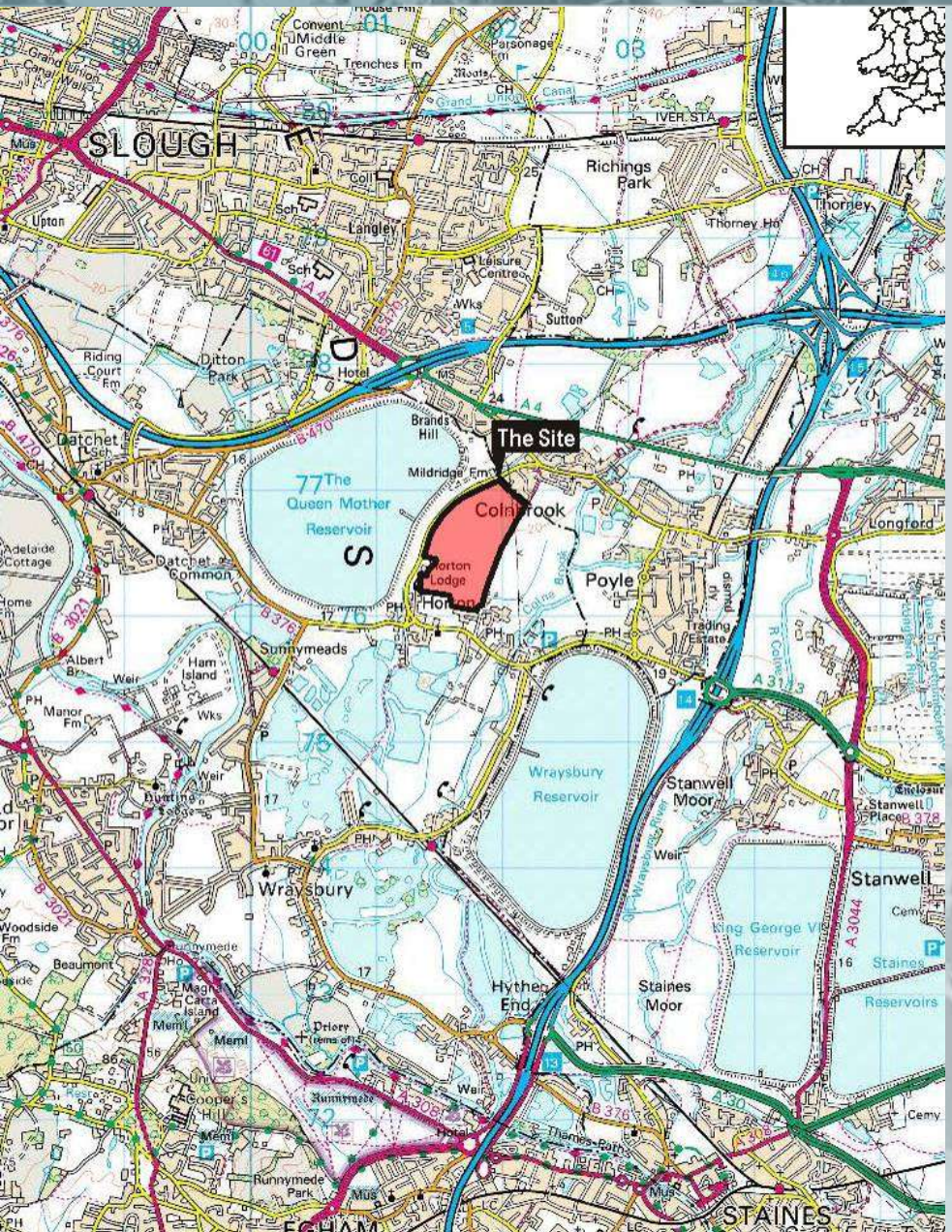
Golder Associates

Case studies - barriers

- Example: Gravel extraction and formation of an inert landfill
- Alluvium and floodplain gravels over Clay
- Gravels have a high hydraulic conductivity and form an unconfined aquifer with a relatively shallow groundwater level
- There was a previous history of groundwater flooding in the area
- Concerns were raised at planning about the impacts of the inert landfill blocking groundwater flow

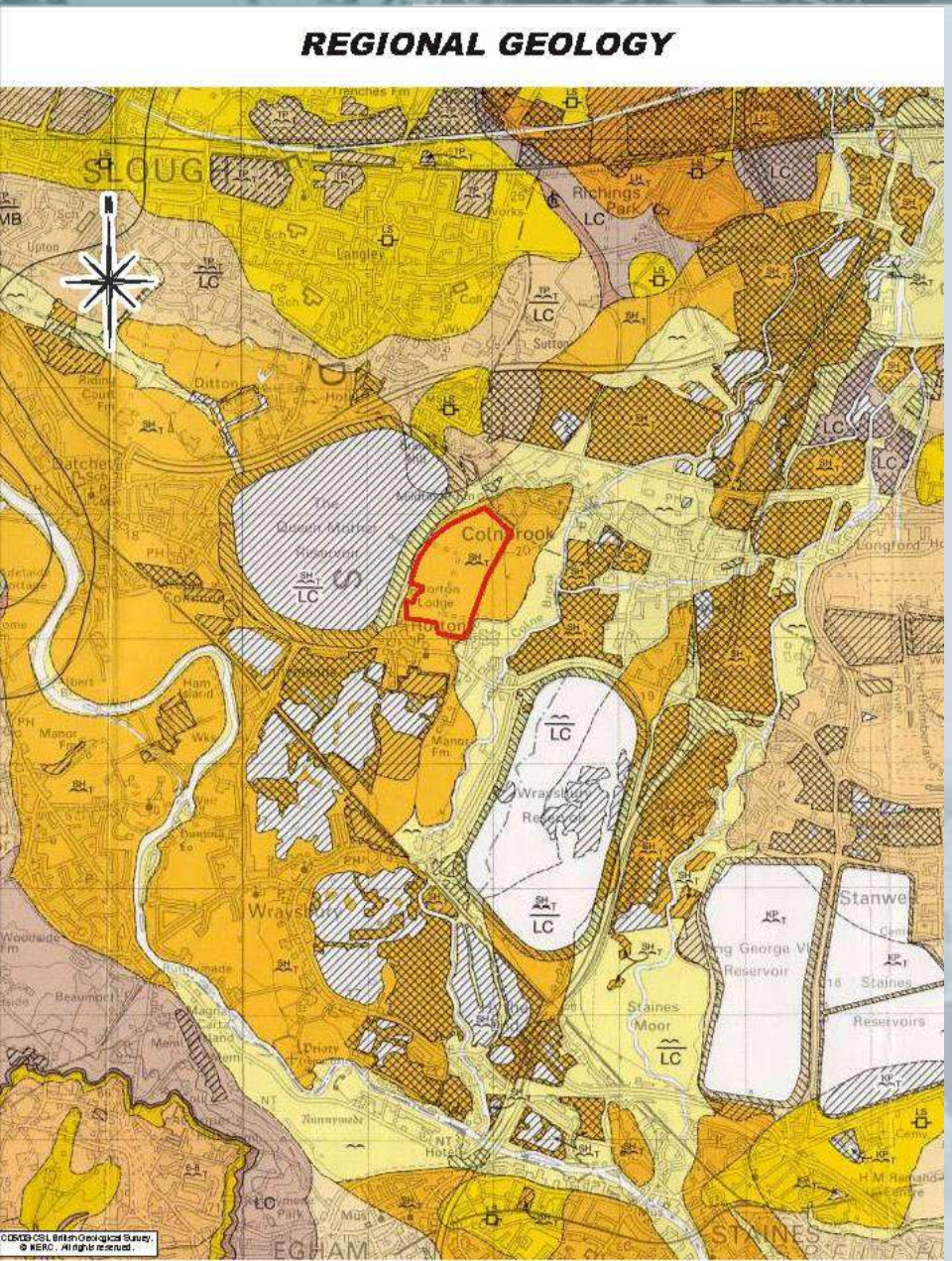
Golder Associates

Case studies - barriers



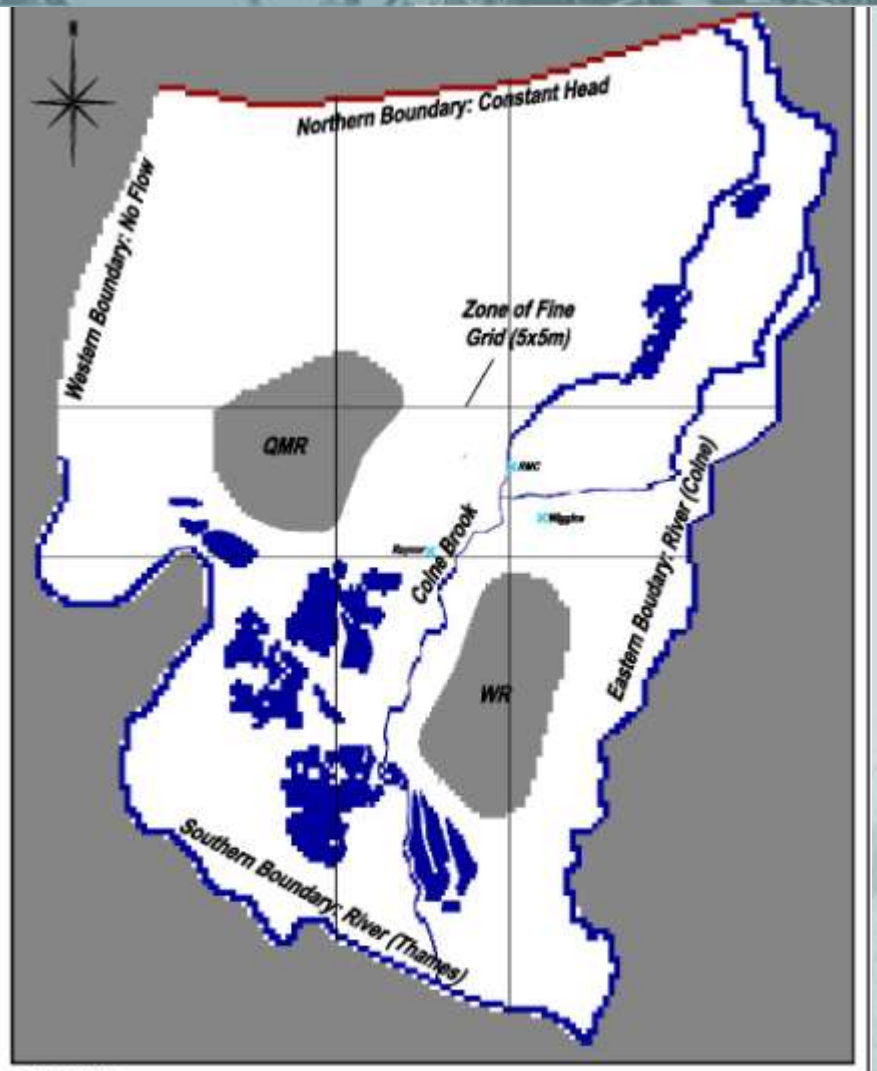
- The site is located between two water supply reservoirs, where the gravel has been removed
- The direction of groundwater flow is approximately north to south

Case studies - barriers



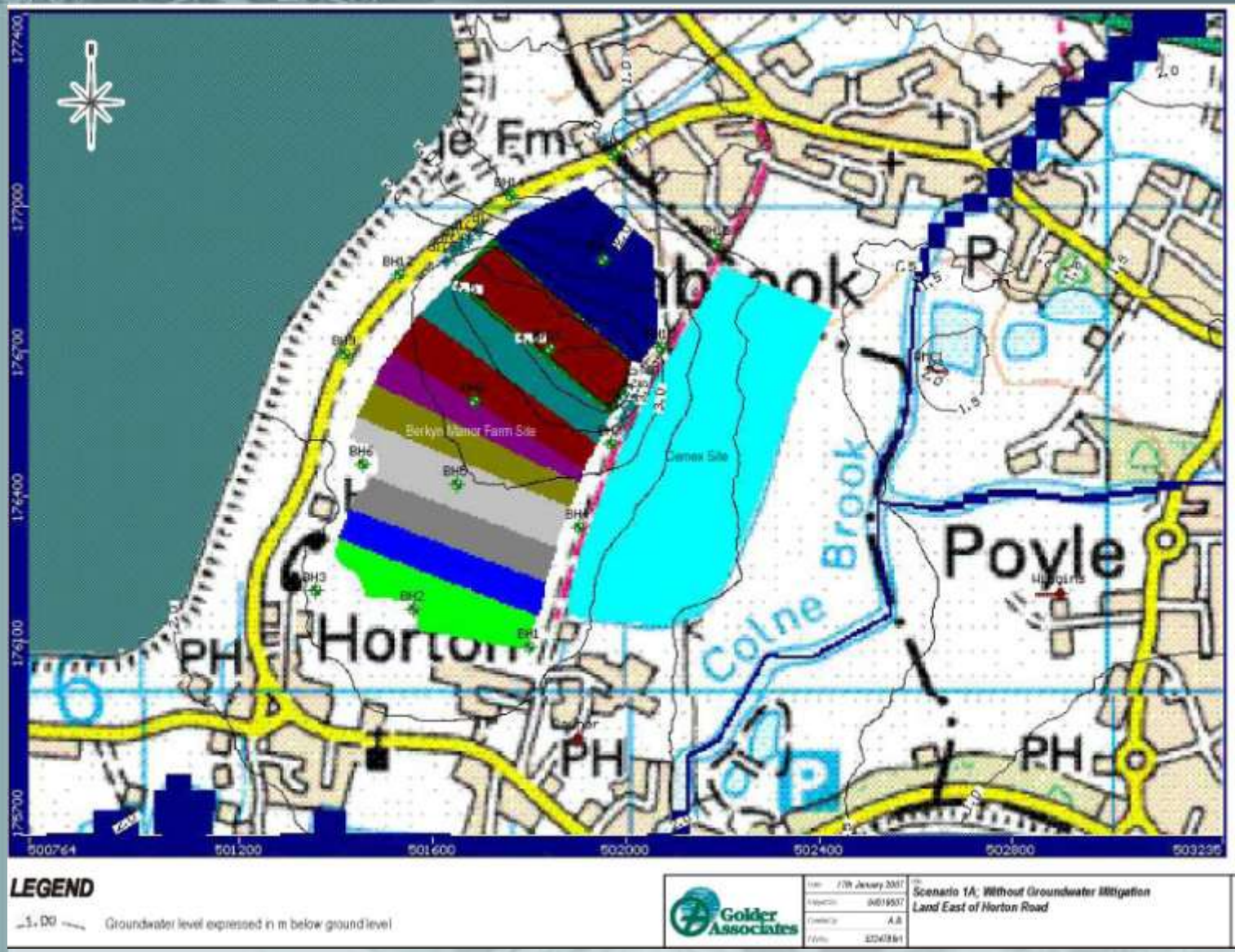
- The hatched areas show where gravel has previously been removed
- The new landfill may block groundwater flow in the remaining gap between the two reservoirs
- Another landfill was proposed (by third parties) to the east of the site

Case studies - barriers



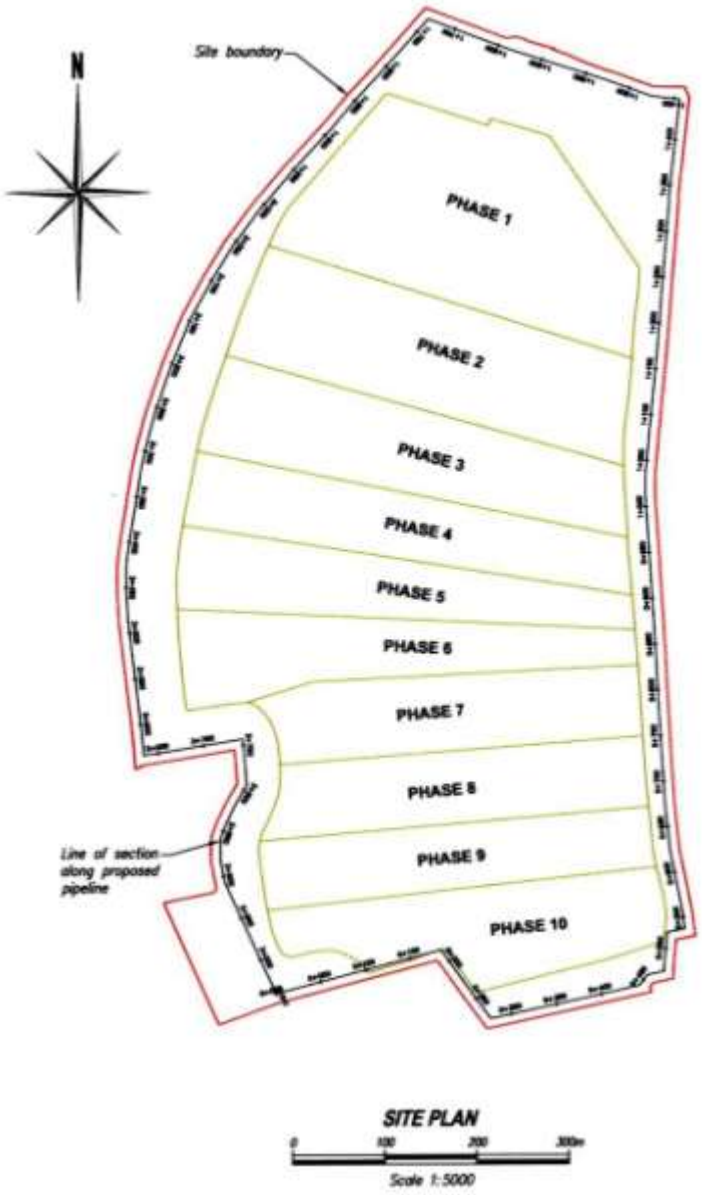
- A 3-dimensional numerical model was constructed using MODFLOW
- The model was calibrated against monitoring data
- Various impact and mitigation scenarios were modelled

Case studies - barriers

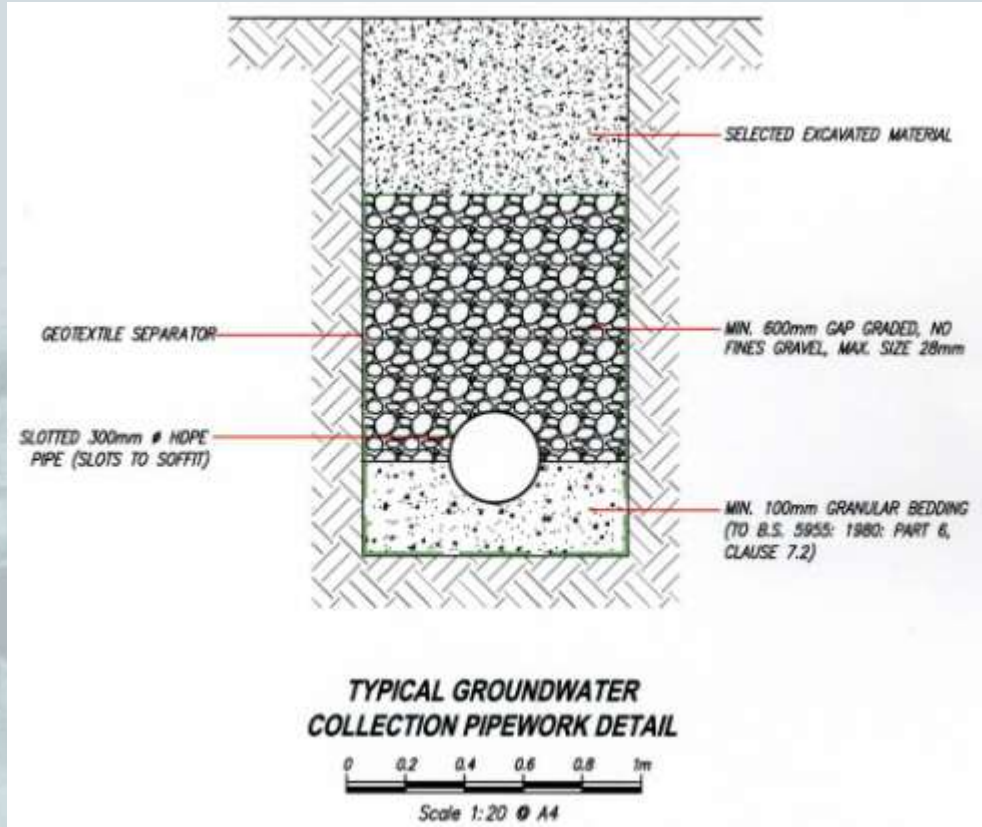


Golder Associates

Case studies - barriers



- Mitigation was proposed in the form of a groundwater drain around the site to allow natural flow to bypass the site and avoid groundwater flooding to the north of the site



Case studies - discharges

Silt pollution of water course due to poorly-controlled sump pumping from chalk

Golder Associates

Case studies - discharges

Simple skip arrangement used as settlement tank

Case studies - discharges

Silt removal from discharge water using geotextile bags

Golder Associates

Monitoring

Monitoring has a key role to play in determining baseline conditions and assessing impacts

- Groundwater levels in wells and boreholes
- Surface water levels in wetlands, streams, etc
- Flow from springs and in associated watercourses
- Water quality parameters at springs or boreholes

The future

- In the future we may need to assess ‘sustainability’ of groundwater control
- We may be able to use wider sustainability assessment tools to compare methods
- It will be interesting to directly compare active (i.e. pumping) methods with more passive (i.e. exclusion) methods

Golder Associates

Conclusion

- There is increasing awareness of the potential impacts that can result from groundwater control
- There is often a focus on direct impacts from abstraction
- But there are other categories of impact
  1. Abstraction
  2. Pathways
  3. Barriers
  4. Discharges to groundwater
  5. Discharges to surface water
- In the future we may look at even wider impacts to compare the ‘sustainability’ of different grounwater control methods

Golder Associates

Assessment of Impacts from Groundwater Control Projects

mpreene@golder.com

Golder Associates